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THE GOVERNOR'S REPORT

THE POTENTIAL FOR DROUGHT IN MONTANA FOR 1998

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Prepared by

Montana Drought Advisory Committee

TABLE OF CONTENTS

SUMMARY 1
    Mountain Snowpack 1
    Reservoir Storage 2
    Soil Moisture 2
    Precipitation 2
    Streamflow 2
    Conclusion 3

INTRODUCTION 4

CURRENT WATER SUPPLY AND MOISTURE CONDITIONS 5
    MOUNTAIN SNOWPACK 5
    STREAMFLOW 6
    RESERVOIRS 6
    PRECIPITATION 7
    DROUGHT INDICES 8
        The Palmer Drought Severity Index 8
        The Surface Water Supply Index 8
    WEATHER and CLIMATE FORECASTS 9
    FIRE DANGER 9

RESPONSES TO LOW WATER SUPPLY AND MOISTURE CONDITIONS 10
    MONITORING AND REPORTING 10
    IMPROVEMENTS 10
    ASSESSMENT AND RESPONSE 11

TABLES

TABLE 1. Remaining Snowpack in Montana and Year-to-Date Precipitation . . . 13
TABLE 2. February 1998 Streamflows in Montana 14
TABLE 3. Status of U.S. Bureau of Reclamation Reservoirs 15
TABLE 4. Status of State-Owned Reservoirs, March 1, 1998 16
TABLE 5. Palmer Drought Severity Indices (PDSI) in Montana 17
TABLE 6. Surface Water Supply Indices, March 1, 1998 18

FIGURE

FIGURE 1. Surface Water Supply Index, March 1, 1998 20

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SUMMARY

The Montana Drought Advisory Committee met February 25, 1998, pursuant to its governing statute, which requires the committee to meet, at a minimum, in February and October of each year to assess moisture and water supply conditions. Generally, member agencies reported that the state's projected water supply and moisture conditions are moderately below average to average. Currently, water supply forecasts call for below average mountain snowpack runoff both east and west of the Continental Divide for spring of 1998. At this time, the likelihood of drought through June is moderate.

A strong El Niño climate signal in Montana since October contributed to low moisture conditions last fall and this winter. The temperature anomaly has been stronger than the precipitation anomaly since January, which is consistent with past El Niño events in Montana. Current long-range climate forecasts call for a weakening of the El Niño signal in spring. However, levels of confidence for El Niño forecasts decrease increasingly as spring and summer approach, and it is difficult at best to predict whether or not Montana will continue to suffer from effects of El Niño into the summer months. Timely precipitation through spring and summer will be necessary to ensure average dryland farming production, adequate streamflow, and low wildfire danger.

The Drought Advisory Committee is charged with monitoring and assessing the state's water supply and moisture conditions, reporting its findings, and when appropriate, developing and implementing effective and timely responses to mitigate drought impacts. Water supply and moisture conditions are summarized briefly below, and in more detail in the following section.

Mountain Snowpack

The Natural Resource Conservation Service (NRCS) Snow Survey reports that, as of March 17, 1998, snow water content (SWE) of mountain snowpack is generally below average throughout the state. The SWEs of the upper Missouri and upper Yellowstone River basins are 85 percent of average. Snow water content of mountain snowpack west of the Continental Divide currently ranges from about 75 to 80 percent of average. Temperatures averaging nearly 5 to10 degrees above average since January are cause for concern that the mountain snowpack could begin to melt earlier than usual. An early runoff of mountain snowpack could serve to leave some irrigators and fisheries on rivers without storage facilities short of water as early as mid-July.

Reservoir Storage

Reservoir storage statewide currently ranges from about 100 to 140 percent of average for this time of year in Montana. Reservoir managers have been retaining storage throughout the winter in anticipation of below average spring runoff due to below average mountain snowpack. Reservoir inflows for the period October through February have been below average to average. Above average storage in many reservoirs is a result of the record runoff last year which provided generous amounts of carry-over storage from last fall.

Soil Moisture

Soil moisture across the state currently ranges from very moist in the southwest and southcentral regions to moderately dry in the northeast and northcentral regions of the state. Precipitation occurring since the last week of February brought needed moisture to dryland farming regions of the eastern part of the state following a dry fall. If the ground thaws before the recent moisture evaporates, soil moisture conditions will improve in the northeast and southeast climate divisions. Soil moisture in the northcentral and central divisions, where most of the state's grains are grown, remains relatively dry and will depend on adequate and timely moisture through June for normal grain production.

Precipitation

The current El Niño event has had a significant impact on precipitation at all elevations statewide, with few exceptions. The National Weather Service (NWS) reported that precipitation across the state ranged from 70 percent of average in the northcentral division to 120 percent of average in the southwest for the period October 1, 1997 through February. The NRCS reports that mountain precipitation ranged from about 60 percent of average along the northern Rocky Mountain Front (east of Continental Divide) to about average in the lower Yellowstone River basin for the period October through February. The NWS reports that precipitation for the period March 1-17, 1998, was about 40 percent above average statewide.

Streamflow

The U.S. Geological Survey reports that streamflow was well above normal for 1997 across the state, which will help support streamflow into 1998. As of March 17, 1998, streamflow ranged from near average in the Clark Fork River basin, west of the Continental Divide, to above average at most active gauges east of the divide. According to the NRCS, streamflow is forecasted to be 74 percent of average west of the Continental Divide, and 82 percent of average east of the divide for the period of April through July 1998.

Conclusion

At this time, the probability of drought in Montana before July is moderate. Dryland agriculture is the primary area of concern due to low soil moisture in the northcentral, central, and northeast climate divisions. Recent moisture will not improve soil moisture conditions until the ground thaws. The Palmer Drought Severity Index values (Table 5.) do not account for the fact that frozen lands keep moisture from entering the soil profile.

Hopefully, recent moisture will remain until such time as the ground thaws allowing it to soak into the soils for plant use. In El Niño years, most of the eastern two-thirds of the state typically experiences low precipitation through the spring. However, climatologists agree that forecasting precipitation becomes more difficult as spring arrives. Dryland farming production success will depend on adequate and timely moisture through June.

Reservoir storage is currently above average, mountain snowpack statewide is about 75 to 85 percent of average, streamflows statewide are forecasted to be about 75 percent of average, and soil moisture ranges from well above to below average. El Niño will most likely continue to influence temperatures and, to a lesser degree, precipitation through spring. It is too early to assess wildfire potential, but at this time forest conditions are relatively normal statewide following abundant moisture in 1997.

The Montana Drought Response Plan defines drought as:

> *Drought is an extended period of below normal precipitation which causes damage to crops and other ground cover; diminishes natural streamflow; depletes soil and subsoil moisture; and because of these effects, causes social, environmental, and economic impacts to Montana.*

At the February 25, 1998 meeting, Chairman Lt. Governor Judy Martz and the committee decided to meet April 16, which coincides with the normal annual peak of the mountain snowpack. The Committee will assess the water supply outlook, soil and forest moisture conditions, and precipitation forecasts at that time.

The Committee asked staff to ensure that the statewide agricultural community be apprised of where to find information concerning moisture conditions and other pertinent information. This report will be sent to all county Farm Service Agency Offices statewide. The Montana State Library's Natural Resource Information System has linked its Internet water information page with the Montana Agricultural Statistics Service Internet page.

Committee member state agencies are expected to review the state drought plan with respect to areas of responsibility, assess anticipated impacts and be prepared to implement appropriate responses in accordance with the state's drought response plan.

INTRODUCTION

In 1991, Montana's Fifty-Second Legislature passed House Bill 537, creating a state drought advisory committee and defining its responsibilities. The law states:

> *By March 15th of each year, the Drought Advisory Committee shall submit a report to the governor describing the potential for drought in the coming year. If the potential for drought merits additional activity by the drought advisory committee, the report must also describe:*
>
> *(a) Activities to be taken by the drought advisory committee for informing the public about the potential for drought;*
>
> *(b) A schedule for completing activities;*
>
> *(c) Geographic areas for which the creation of local drought advisory committees will be suggested to local governments and citizens; and*
>
> *(d) Requests for the use of any available state resources that may be necessary to prevent or minimize drought impacts (Section 2-15-3308 MCA 1991).*

This report is divided into two sections. The first section, *Current Water Supply and Moisture Conditions*, includes current data on the state's water storage supply, soil moisture, mountain snowpack, streamflow, weather forecasts, precipitation, and fire conditions. The second section, *Responses to Water Supply and Moisture Conditions*, provides an assessment of the probability of drought in coming months given current conditions, and the Drought Advisory Committee's response to that assessment. An update of improvements to the state's drought monitoring and response system is also included.

CURRENT WATER SUPPLY AND MOISTURE CONDITIONS

The Department of Natural Resources and Conservation (DNRC) prepares the *Water Supply and Moisture Condition Report* monthly, from February through October of each year. This report summarizes information on current and projected water supplies and soil moisture conditions collected by a variety of federal and state agencies. It is used by the Drought Advisory Committee (committee) to monitor water supply and moisture conditions as part of the state's drought management strategy. The *Governor's Report* replaces DNRC's report for the month of March, and includes the same data.

Included are data from the U.S. Geological Survey (USGS), National Weather Service (NWS), U.S. Bureau of Reclamation, Natural Resource Conservation Service (NRCS), DNRC, and the Montana Agricultural Statistics Service. The Montana State Library's Natural Resource Information System (NRIS) generates a map of the state showing the Surface Water Supply Index (SWSI) for 52 river basins. The Palmer Drought Severity Index (PDSI), which rates soil moisture, is provided by the NWS for the seven climate divisions of the state.

MOUNTAIN SNOWPACK

Most of the annual streamflow in Montana originates as snowfall which accumulates high in the mountains during fall, winter, and spring. As the snowpack accumulates, hydrologists estimate the runoff that will occur when it melts. Aquifers, lakes, streams, and reservoirs are largely dependent on runoff from mountain snowpack. Montana's mountain snowpack accumulates at a relatively constant rate from November through mid-April of each year. Mountain snowpack generally accounts for 80 percent of streamflow in spring and early summer in western Montana.

The NRCS Snow Survey maintains a network of automated remote gaging stations, known as SNOTEL, throughout the mountainous regions of the state. The stations in this system record snow water equivalent, precipitation, and temperature and transmit the data daily, via telemetry to a central data collection facility. NRCS and National Weather Service hydrologists formulate monthly streamflow forecasts for the coming spring and summer, which are summarized monthly in NRCS Montana Basin Outlook Reports.

Snow water equivalent (SWE) figures indicate the current water content of snowpack. SNOTEL reports also provide cumulative figures, by river basin, for the year's total precipitation. The NRCS "water year" for data collection and record-keeping commences on October 1 of each year and ends September 30 of the following calendar year. The current data base used by NRCS covers the period of record 1961-90.

According to the March 1, 1998 NRCS Montana Basin Outlook Report, snowpack SWE statewide was 77 percent of average. Almost all major river basins in Montana currently have mountain snowpack SWEs below average for this time of year, with the exception of the lower Yellowstone, which is about average. As of March 9, the Missouri headwaters SWE was 85 percent of average, with the Jefferson at 83, the Madison at 88, and the Gallatin at 85 percent of average. The upper Yellowstone SWE is 83 percent of average. West of the Continental Divide, SWE was 73 percent of average as of March 1. East of the divide, the SWE was 83 percent of average and 57 percent of SWE last year at this time. Snowpack totals are updated through March 9, 1998 in **Table 1. *Remaining Snowpack in Montana***.

STREAMFLOW

The U.S. Geological Survey (USGS) operates and monitors five long-term stream gauging stations reported in **Table 2. *February 1998 Streamflows in Montana***. For the month of February, monthly mean streamflows were normal at two, below normal at two, and above normal at one of five long-term streamflow monitoring stations. Comprehensive and accurate streamflow monitoring does not begin until rivers are clear of ice, usually in May.

According to the USGS February Streamflow Report, the mean February flow for the Yellowstone River at Billings was 3,030 cubic feet per second, or 110 percent of average. Streamflow of the Clark Fork River at St. Regis and the Middle Fork of the Flathead River near West Glacier were 81 and 62 percent of average, respectively, for the month of February. Streamflow for the Marias River near Shelby was 74 percent of average, and the Yellowstone River at Corwin Springs was 147 and percent of average. Record level streamflows in 1997 continue to have a positive influence on streamflow.

According to the NRCS March 1, 1998 Montana Basin Outlook Report, streamflows statewide are forecasted to range from about 70 to 95 percent of average for the period of April through July. Streamflow west of the Continental Divide is forecasted to be about 70 percent of average for the upper and lower Clark Fork River basin, 80 percent for the Bitterroot, and about 75 percent of average for the Flathead and Kootenai basins. East of the divide, streamflow for the same period is forecasted to be 87 percent of average for the Madison, about 80 for the Missouri, and about 90 for the Gallatin and Yellowstone rivers.

RESERVOIRS

Storage in the major reservoirs across the state was 117 percent of average and 127 percent of levels recorded last year at this time, according to the NRCS Basin Outlook Report. West of the Continental Divide, reservoirs were 121 percent of average and 137 percent of March 1, 1997 levels. East of the divide, reservoirs were 110 percent of average and 110 percent of storage on March 1 of last year. Reservoir operators plan to hold stored water longer than last year in anticipation of below average runoff of the mountain snowpack. With the exception of Gibson Reservoir on the Sun River, no water shortages are anticipated at Reclamation reservoirs for the coming irrigation season (see **Table 3. *Status of Bureau of Reclamation Reservoirs***).

State-owned reservoir storage levels currently range from about 100 to 140 percent of normal as of March 1, 1998, (see **Table 4. *Status of State-Owned Reservoirs***, March 1, 1998). Storage contents averaged close to levels reported at this time last year. State projects with less storage capacity are maintained at low levels until the latter stages of annual spring runoff. No shortages are expected at state-owned reservoirs, with the exception of the Tongue River Project, which may be slightly less than average due to construction activities.

PRECIPITATION

The National Weather Service reported that from October 1, 1997 through February 28, 1998, precipitation statewide was below average to about average. The following table summarizes precipitation, as recorded at valley locations for the period:

Precipitation Statewide, October 1, 1997 - February 28, 1998
Percent of Average

Division	10/1/97 - 2/28/98	2/1/98 - 2/28/98
Western	68	33
Southwest	119	95
Southcentral	84	47
Central	75	41
Northcentral	72	38
Southeast	93	182
Northeast	88	252

The National Weather Service reports that precipitation for the period March 1-17 was 191 percent of average in the northwest climate division, 174 percent in the southwest, 125 percent in the northcentral, 153 percent in the central, 168 percent in the southcentral, 135 percent in the northeast, and 42 percent of average in the southeast division. The NWS reports that over the past 106 winters (since 1892) in Great Falls, 1997-98 tied three previous winters as the 26th warmest, and was the 31st driest of record.

According to the March 1, 1998 NRCS Montana Basin Outlook Report, mountain and valley precipitation for October through February was 84 percent of average and 59 percent of last year east of the Continental Divide, and 79 percent of average and 55 percent of last year west of the divide. February precipitation was 43 percent of average west of the divide and 52 percent of average east of the divide.

According to the Montana Climate Atlas (Caprio and Nielsen, 1992), precipitation amount and frequency increase east of the Continental Divide in late March as moisture from the Gulf of Mexico and Pacific Coast begins to penetrate northward. In April, wet snow or rain typically leave more than an inch of precipitation across the southern tier of the state. Precipitation in the northeast and northcentral regions doubles in April from March levels to over one inch. Normally, a series of storms in April and early May bring several inches of precipitation to the plains region of the state. *These storms typically fail to materialize in drought years*, according to the authors. Mountains along the divide in the far north and south of the state normally receive more than six inches of precipitation in April.

DROUGHT INDICES

The Palmer Drought Severity Index (PDSI), indicates long-term effects to soil moisture of precipitation shortfalls in rangeland, dryland crop areas, and timberlands. The Surface Water Supply Index (SWSI) is a composite index generated by the NRCS that forecasts surface water supply.

The Palmer Drought Severity Index

The Palmer Drought Severity Index (PDSI) indicates that drought conditions are not present at this time, with the exception of the northeast, which is classified currently as in *moderate* drought due to residual dry conditions of 1997. The PDSI figures do *not* reflect the fact that recent moisture may not enter the soil profile if the earth is frozen. PDSI is based on measured precipitation, estimated evapotranspiration, and local climatic characteristics, and is prepared for seven regions of the state (see **Table 5, *Palmer Drought Severity Indices in Montana***).

The Surface Water Supply Index

The Natural Resource Conservation Service (NRCS) generates the Surface Water Supply Index (SWSI) as an index of surface water availability for Montana river basins based on mountain snowpack, mountain precipitation, streamflow, soil moisture, and reservoir storage. The SWSI is used to forecast surface water supply, and is best applied to mountainous areas with surface water supplies that are primarily dependent on spring runoff of mountain snowpack (**Figure 1. *SWSI Values as of March 1, 1998***).

As of March 1, most of the state's river basins range from *near average* to *moderately dry,* with 22 of 52 reported basins rated as *moderately dry*, 15 basins as *slightly dry*, and 14 near average. The Teton River basin registers a SWSI of -3.1, in the *extremely dry* category, and (see **Table 6. *Montana Surface Water Supply Indices, March 1, 1998***).

WEATHER AND CLIMATE FORECASTS

The National Weather Service (NWS) six to ten-day forecast for March 26-30 calls for temperatures to be above normal for the entire state and precipitation to be normal for the entire state, with the exception of the southeast division, which is forecast to be wetter than normal. The Montana Climate Atlas (Caprio and Nielsen, 1992, map 17) indicates that, "*In March, the state is less influenced by cold northern air masses. Warm, moist southwest air flow creates a situation more favorable for precipitation in the southern plains of Montana.*"

NOAA's Climate Prediction Center 30-day outlook for March calls for above normal temperatures for the northwest region and slightly above normal for the remainder of the state. Below average precipitation is forecasted for the central one-third of the state. The 90-day outlook for March through May calls for above normal temperatures for the northwest region of the state, and slightly above normal temperatures for the rest of the state. Precipitation over the same period is expected to be normal for the entire state.

FIRE DANGER

Dry conditions in fall of 1997 increased the potential for wildfire slightly in forested regions of the state following last summer's wet and inactive fire season. This year's below average mountain snowpack *may* increase the potential for forest wildfire in the summer months. It is premature, however, to assess the potential for forest wildfire for summer 1998.

Vast tracts of prairie lands enrolled in the Conservation Reserve Program are densely covered with dry grasses, creating a considerable amount of fuel for prairie wildfires. Fire conditions on these lands can change quickly with dry, windy weather. DNRC and the U.S. Forest Service will begin assessing wildfire potential on a regular basis in mid-April. Information regarding conditions will be released shortly thereafter through news releases and to the committee chairman by staff.

RESPONSES TO WATER SUPPLY AND MOISTURE CONDITIONS

The potential for drought in 1998 warrants continued monitoring and reporting by the Drought Advisory Committee through the spring. At the February 25, 1998 meeting, the committee selected April 16 as the date for the next meeting, to be held in Helena. At that time, the committee will assess conditions and make recommendations consistent with the plan. The plan's levels of response are not triggered before April 15 of a given year.

MONITORING AND REPORTING

Early season drought management focuses on monitoring water supply and soil moisture conditions and keeping the public apprised of the potential for drought. The committee will most likely continue to meet into the summer, given the continued effects of El Niño on Montana, which typically include above average temperatures and below average precipitation through the summer months. Federal and state agencies that monitor water supply and moisture conditions will continue reporting through the committee and media on a regular basis. Updated information will be placed on Internet pages listed below on a regular basis.

IMPROVEMENTS

Over the last year, the drought monitoring information system has been improved. Each month, the drought monitoring data and SWSI water supply map are entered on the Internet on the NRIS Home Page. The Montana State Library Natural Resource Information System (NRIS) Internet address is: **http://nris.mt.gov/** Go to the water information area and then to water supply and drought. Links are provided to real-time snowpack, reservoir, and streamflow data. A number of climate data links provide El Niño updates and status reports. The National Drought Mitigation Center has many useful links to agricultural Internet sites.

Th Montana Department of Agriculture has a variety of information useful to farmers and ranchers, including the Hay Hotline. The Internet address is: **http://agr.mt.gov/**

Montana Agricultural Statistics Service Internet address is: **http://www.nass.usda.gov/**

Montana Department of Natural Resources and Conservation is: **http://www.dnrc.mt.gov/**

ASSESSMENT AND RESPONSE

Records maintained by the NRCS Snow Survey indicate that by March 15 of each year, approximately 90 percent of the annual mountain snowpack is in place, allowing fairly accurate projections of water supply to irrigators and river systems in coming months. Absent unseasonably warm weather or excessive rain on the mountain snowpack, spring runoff is expected to occur between late April and June as normal.

From January to June, the NRCS forecasts streamflow for fifteen major river basins of the state, on a monthly basis, reflecting changes in the snow water content of the mountain snowpack. The NRCS March 1, 1998 Montana Basin Outlook Report projects streamflow for April through July to range, for the most part, between 70 and 90 percent of average statewide. Reservoir storage is currently being retained so reservoirs can supplement current contents with the below average runoff anticipated from the mountain snowpack currently in place and prevent water shortages to irrigators this summer.

At this time, the probability of drought in Montana before July is moderate. Dryland agriculture is the primary area of concern due to low soil moisture in the northcentral, central, and northeast climate divisions. Recent moisture in the form of a snowstorm the last week of February cannot improve soil moisture conditions significantly until the ground thaws. The Palmer Drought Severity Index does not take into account the fact that the ground is still frozen preventing moisture from entering the soil profile. Hopefully, moisture from spring snowstorms will remain until such time as the ground thaws allowing it to soak into the soil in time for planting. In El Niño years, the eastern two-thirds of the state typically experiences low precipitation through the spring. Dryland farming production success will depend on average and timely moisture through June.

Reservoir storage is above average, mountain snowpack statewide is about 75 percent of average, streamflows statewide are forecasted to be about 75 percent of average, and soil moisture ranges from well above to below average. El Niño will most likely continue to influence temperatures and to a lesser degree, precipitation through spring. It is too early to assess wildfire potential, but at this time forest conditions are relatively normal statewide following abundant moisture in 1997.

Presently, the prospects for water supply shortfalls are moderate. The drought plan's initial triggering level, *Drought Alert,* is not activated until April 15, although one river basin, the Teton, has a SWSI of -3.1, which would trigger the *Alert* status *after* April 15. The committee will continue to monitor conditions closely in coming months as the mountain snowpack accumulates and water supply prospects become more firm. Precipitation patterns tend to take form in April, about the time planting occurs. Dryland farming production will depend on the suitability of conditions for planting in April, with timely precipitation from March through June. Wildfire potential will be assessed in April and monitored through summer and into fall.

TABLES

TABLE 1.

Remaining Snowpack in Montana and Year-to-Date Precipitation(1) Based on Mountain Data from NRCS SNOTEL Sites As of March 9, 1998

Basin	Remaining Snow Water Equivalents(2) (% of average)(3)	Year-to-Date(4) Precipitation (% of average)
Kootenai River	77	82
Flathead River	74	77
Upper Clark Fork River	75	77
Bitterroot River	79	82
Lower Clark Fork River	68	75
Jefferson River	83	84
Madison River	88	87
Gallatin River	85	82
Missouri River Headwaters	85	84
Headwaters Missouri Mainstem	78	76
Smith, Judith, & Musselshell Rivers	71	74
Sun, Teton, & Marias Rivers	58	66
Missouri Mainstem River Basin	67	71
St. Mary River	74	75
Upper Yellowstone	83	85
Bighorn River (Wyoming)	93	102
Tongue River (Wyoming)	93	111
Powder River (Wyoming)	96	100
Lower Yellowstone	94	100

Notes

(1) Information taken from Natural Resource Conservation Service Snow-Precipitation Update.
(2) A "snow water equivalent" is the depth of snow equivalent to one inch of water.
(3) Reference period for average conditions is 1961-90.
(4) October 1, 1998 to present.

TABLE 2.

February 1998 Streamflows in Montana[1]

Station Name	Mean Flow (2) February, 1998 (cfs)	1966-95 Average Discharge in cu.ft./sec.	% of Average
Marias River near Shelby	261 (e)	354	74
Yellowstone River at Corwin Springs	1,230	838	147
Yellowstone River at Billings	3,030	2,750	110
Middle Fork of Flathead near West Glacier	459	740	62
Clark Fork River at St. Regis	2,880	3,540	81

Notes

(1) Information is provided by the U.S. Geological Survey (USGS). According to the USGS, the five gaging sites in Table 1 are representative of streamflow conditions throughout Montana.

(2) Data is provisional and subject to revision.

(e) Figure presented is an estimate.

TABLE 3.[1]

Status of U.S. Bureau of Reclamation Reservoirs

		3/1/98		Year Ago (3/1/97)	
Reservoir	Drainage	Content[2] (ac-ft)	% of Avg.	Content[2] (ac-ft)	% of Avg.
Clark Canyon	Beaverhead	166,000	114	155,100	107
Canyon Ferry	Missouri	1,675,500	106	1,362,900	86
Gibson	Sun River	44,600	94	35,100	74
Lake Elwell	Marias River	781,000	112	748,500	107
Sherburne	St. Mary River[3]	32,400	130	31,500	127
Fresno	Milk River	50,000	117	69,100	162
Nelson	Milk River	66,300	123	49,800	92
Bighorn Lake	Bighorn River	883,600	105	778,400	93
Hungry Horse	South Fork Flathead River	2,397,900	110	1,720,400	79

Notes

(1) Information from U.S. Bureau of Reclamation.

(2) "Content" refers to active contents only (dead storage not included).

(3) Interbasin diversion from St. Mary River to North Fork Milk River.

TABLE 4.

Status of State-Owned Reservoirs(1)
March 1, 1998

Reservoir	Drainage	March 1, 1998 Storage (ac-ft)	March 1, 1998 % of Avg.	March 1, 1998 % of Capacity	Year Ago (3/1/97) Storage (ac-ft)	Year Ago (3/1/97) % of Avg.
Missouri River Basin						
Ackley Lake	Judith River	4,480	120	77	2,340	63
Bair	Musselshell	4,090	97	58	2,630	69
Deadman's Basin	Musselshell	62,840	136	87	50,280	110
Martinsdale	Musselshell	15,810	169	68	9,750	101
Middle Creek(2)	Gallatin River	7,900	205	78	6,940	187
Nilan	Sun River	9,590	136	95	7,069	100
North Fork of Smith	Smith River	8,870	133	77	6,220	94
Petrolia	Musselshell	8,140	136	92	5,500	92
Ruby River	Ruby River	29,960	110	77	27,710	116
Yellowstone Basin						
Cooney	Rock Creek	20,050	131	71	16,470	107
Tongue River	Tongue River	6,990	23	10	23,130	92
Clark Fork River Basin						
East Fork of Rock Creek	Rock Creek	14,250	122	89	3,590	37
Nevada Creek	Blackfoot River	6,870	137	54	3,750	87
Painted Rocks	Bitterroot River	2,340	18	7	5,570	57

Notes

(1) Information from Montana Department of Natural Resources and Conservation, State Water Projects Bureau.

(2) Reservoir storage data is estimated.

TABLE 5.

Palmer Drought Severity Indices (PDSI) in Montana(1)

District	**PDSI 3/7/98**	PDSI 10/18/97	Precipitation to End Drought (inches)	
			3/7/98	10/18/97
Northwest	**+2.3**	-0.7	**0.00**	0.37
Southwest	**+3.7**	+2.1	**0.00**	0.00
Northcentral	**+0.8**	-2.5	**0.00**	2.06
Central	**+1.4**	-0.6	**0.00**	0.13
Southcentral	**+3.9**	+0.1	**0.00**	0.00
Northeast	**-2.1**	-2.9	**1.22**	2.60
Southeast	**0.0**	-1.9	**0.00**	1.70

Explanation: The Palmer Drought Severity Index describes the intensity of prolonged wet or dry periods as shown below.

Range	Description
+4.0 and greater	Extremely moist spell
+3.0 through +3.99	Very moist spell
+2.0 through +2.99	Unusually moist spell
+1.0 through +1.99	Moist spell
+0.5 through +0.99	Incipient moist spell
-0.49 through +0.49	Normal
-0.5 through -0.99	Incipient Drought
-1.0 through -1.99	Mild drought
-2.0 through -2.99	Moderate drought
-3.0 through -3.99	Severe drought
-4.0 and less	Extreme drought

Notes

(1) Palmer Drought Severity Indices provided by Climate Analysis Center, Wash., D.C.

Table 6. Surface Water Supply Indices, March 1, 1998 (See Figure 1)

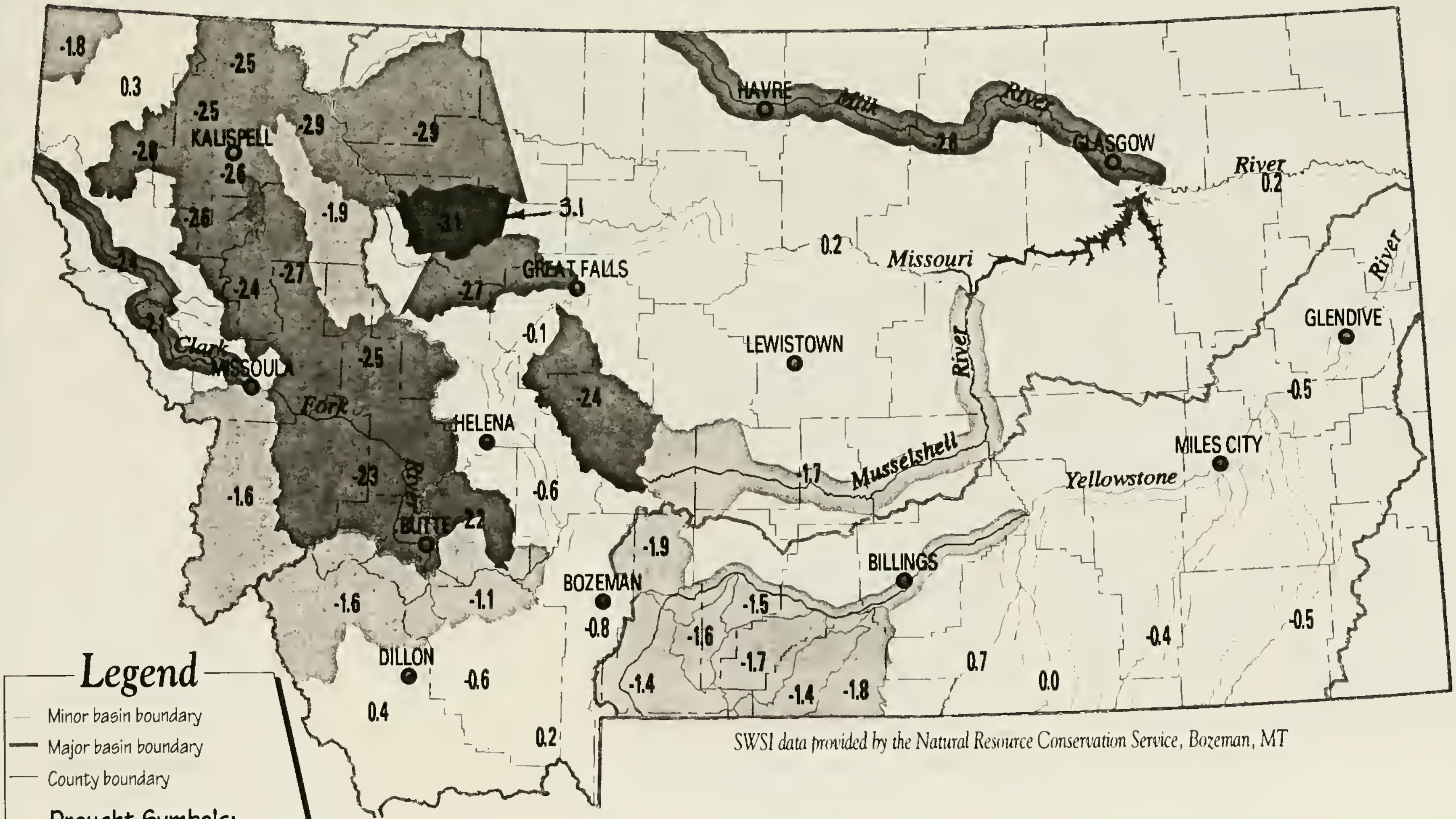
Table 6.

Montana Surface Water Supply Indices (SWSIs)
March 1, 1998

Basin	SWSI	Basin	SWSI
Tobacco River	-1.3	Gallatin River	-0.8
Kootenai River below Libby Dam	+0.3	Missouri River above Canyon Ferry	-0.6
Fisher River	-2.8	Missouri River below Canyon Ferry	-0.1
Yaak River	-1.8	Smith River	-2.4
North Fork Flathead River	-2.5	Sun River	-2.7
Middle Fork Flathead River	-2.9	Teton River	-3.1
South Fork Flathead River	-1.9	Birch/Dupuyer Creeks	-2.7
Flathead River at Columbia Falls	-2.4	Marias River	-2.9
Stillwater/Whitefish Rivers	-2.5	Musselshell River	-1.7
Swan River	-2.7	Missouri above Fort Peck Reservoir	+0.2
Flathead River at Polson	-2.6	Missouri River below Fort Peck	+0.2
Mission Valley	-2.4	Milk River	-2.6
Little Bitterroot River	-2.6	Yellowstone River above Livingston	-1.4
Blackfoot River	-2.5	Shields River	-1.9
Clark Fork River above Missoula	-2.3	Boulder River (Yellowstone)	-1.6
Bitterroot River	-1.6	Stillwater River	-1.7
Clark Fork River below Bitterroot River	-2.1	Rock/Red Lodge Creeks	-1.4
Clark Fork River below Flathead River	-2.4	Clarks Fork River	-1.8
Beaverhead River	+0.4	Yellowstone above Bighorn River	-1.5
Ruby River	-0.6	Bighorn River	+0.7
Big Hole River	-1.6	Little Bighorn River	0.0
Boulder River (Jefferson Basin)	-2.2	Yellowstone R. below Bighorn River	-0.5
Jefferson River	-1.1	Tongue River	-0.4
Madison River	+0.2	Powder River	-0.5

Note: The Surface Water Supply Index (SWSI) is an indicator describing predicted surface water availability during spring and summer months. The March 1, 1998 SWSI describes surface water supply conditions prior to the beginning of the 1998 growing season.

FIGURE



SWSI data provided by the Natural Resource Conservation Service, Bozeman, MT

Legend

- Minor basin boundary
- Major basin boundary
- County boundary

Drought Symbols:

- ■ Extremely wet (3.0 to 4.0)
- ☐ Moderately wet (2.0 to 3.0)
- ☐ Slightly wet (1.0 to 2.0)
- ☐ Near average (-1.0 to 1.0)
- ▨ Slightly dry (-2.0 to -1.0)
- ■ Moderately dry (-3.0 to -2.0)
- ■ Extremely dry (-4.0 to -3.0)
- ☐ No data available or SWSI not applicable

Surface Water Supply Index (SWSI) Values:
March 1, 1998

NOTE: SWSI values primarily indicate water supply conditions for irrigated lands within each basin. The SWSI index includes reservoir, streamflow, precipitation, and soil moisture data. The values shown may be based on provisional data and subject to change.

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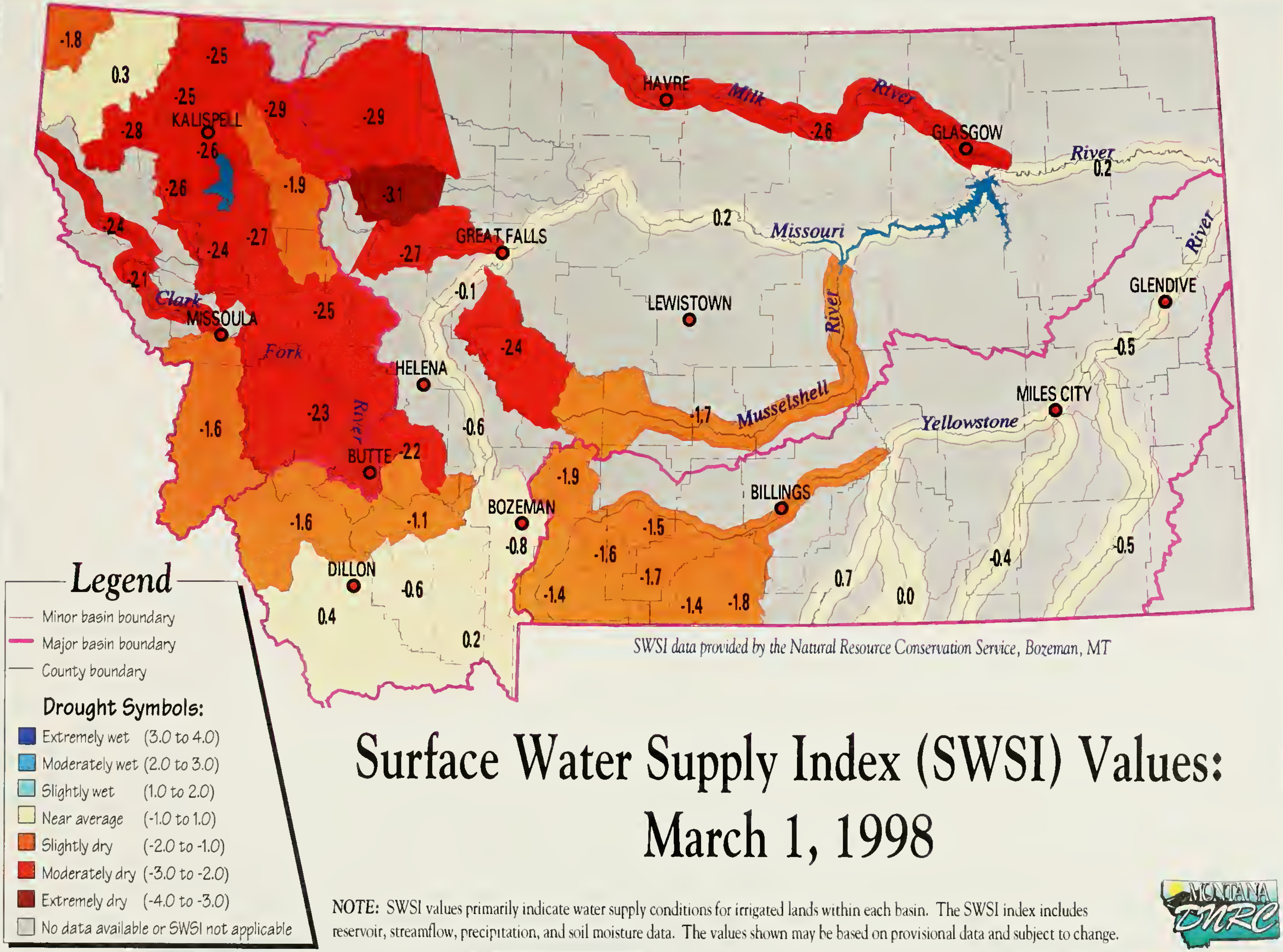

SWSI data provided by the Natural Resource Conservation Service, Bozeman, MT

Surface Water Supply Index (SWSI) Values:

March 1, 1998

NOTE: SWSI values primarily indicate water supply conditions for irrigated lands within each basin. The SWSI index includes reservoir, streamflow, precipitation, and soil moisture data. The values shown may be based on provisional data and subject to change.

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